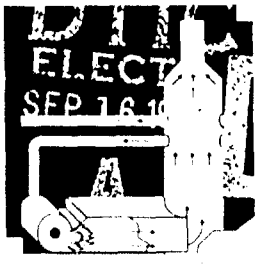
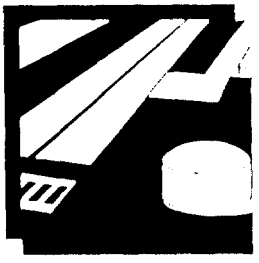
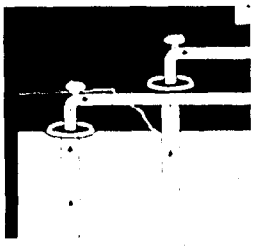
BASEWIDE ENGINEERING EVALUATION-COST ANALYSIS FOR SOIL VAPOR EXTRACTION

SITE SPECIFIC DOCUMENT OU D / SITE 3







McClellan Air Force Base

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SITE SPECIFIC DOCUMENT OU D / Site 3

McClellan Air Force Base

September 1993
Draft Final

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Section 1
INTRODUCTION

This document supports the use of soil vapor extraction (SVE) as the non-time-critical removal action for areas contaminated with volatile organic compounds (VOCs) in the vadose zone around Site 3, which is located in Operable Unit D (OU D). This SVE removal action is part of the initial basewide SVE removal action at McClellan Air Force Base (McAFB). The principal objective of the basewide SVE removal action is to achieve early risk reduction by removing a significant quantity of VOCs from soils in the vadose-zone, intercepting an exposure pathway, or preventing additional flux to groundwater.

This document is a companion to the Basewide Engineering Evaluation-Cost Analysis (EE/CA) General Evaluation Document. The General Evaluation Document provides the long-term plan to standardize and streamline the use of SVE removal actions at McAFB by establishing SVE as the presumptive remedy for removal of VOCs from the vadose-zone; outlining a site selection methodology for SVE removal actions; and providing a baseline SVE system configuration and cost estimate.

This site-specific EE/CA for OU D/Site 3 focuses on information to supplement the General Evaluation Document in support of the SVE removal action around Site 3. In particular, this document demonstrates that Site 3 satisfies the criteria outlined in the site selection methodology of the General Evaluation Document. Since the General Evaluation Document establishes the case for SVE as the presumptive remedy, this document contains no evaluation of alternatives.

Section 2
SITE CHARACTERIZATION

There are 12 former waste pits in OU D (figure 2-1) that were used from the early 1940s through 1981 for sludge disposal, refuse burial, and oil burning. Industrial sludges (an estimated 38,000 cubic yards), waste solvents, fuels, and oils were disposed of in these pits. In 1985, an 8-acre, multi-layer, low-permeability cap was installed to cover 8 pit sites. A gas collection system was installed with the cap to collect and vent vapors. The purpose of the cap was to limit rainwater infiltration and downward migration of contaminants.

Shallow and deep soil gas contamination has been observed off-base, along the western border of OU D. In response to these observations, an SVE removal action is being initiated to identify and intercept the source of the off-base soil gas. Several sites near the western edge of OU D were considered for this removal action, including Site 3, Site S, Site 2, and Site 4.

Site 3 is a trench approximately 1,100 feet long, 50 feet wide, and about 30 feet deep, located within 50 feet of the base boundary. The trench was used from 1962 to 1965 and received trichloroethylene (TCE) waste from 1962 to 1963. During the operation of the trench, open burning of oil and solid waste also occurred. Between 1965 and 1975, JP-4 fuel may have been burned for fire training exercises in this general area. About 22,700 cubic yards of refuse, debris, and sludge are present in the trench (CH2M Hill, 1992).

About 200 feet east of Site 3 is Site S, where the SVE treatability operation has removed about 46,000 pounds of VOC contaminants in eight weeks of operation. Extraction wells at Site S are located within and along the boundaries of the Site S pit, and are presumed to be within an area of high original contamination that has migrated into the soil.

Sites 2 and 4 are trenches located about 150 feet to the east of Site 3, oriented parallel to Site 3 (figure 2-1). Although not yet sampled, these two sites also are potential contaminant sources. A number of overlapping plumes may exist below the engineered cap, and any one of these could contribute to the soil-gas concentrations observed in the off-base vadose-zone monitor wells.

Site 3 has been selected as the focus of the first application of SVE for three reasons: (1) Site 3 is the westernmost known disposal site in OU D; (2) its historical waste disposal practices suggests it as a potentially significant source; and (3) the site parallels the base boundary and is near the edge of the cap. Additional investigative borings will be drilled at Site 3 to identify VOC sources and to serve as potential extraction wells to intercept any off-base migration of contaminated gas from other sources in OU D lying to the east of Site 3.

Section 2

Site 3 Capped Waste Pit (looking north)

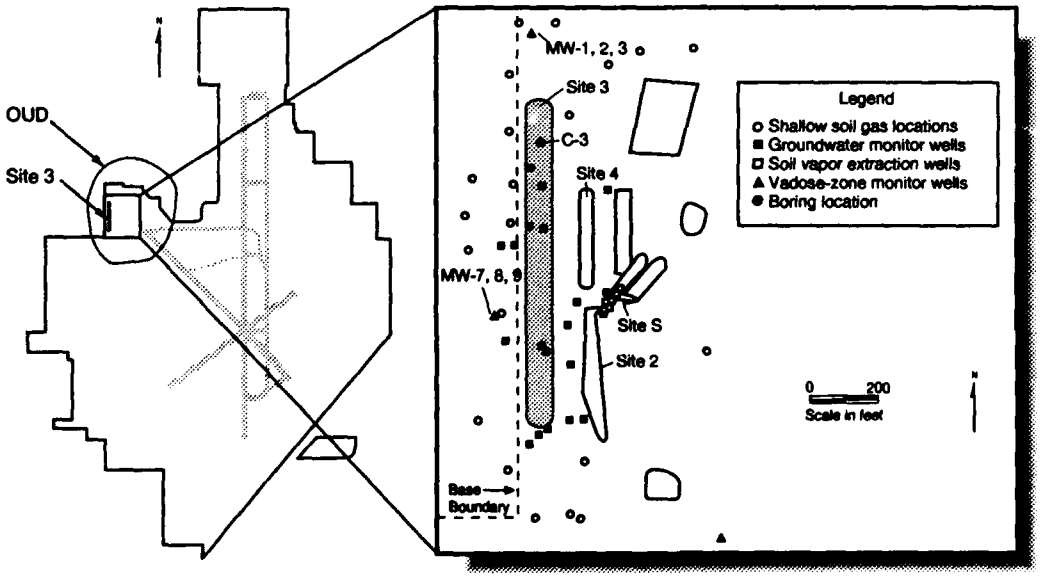

Figure 2-1
OU D /Site 3 Location Maps and Photo

Section 2

Investigation Results: Soil and Soil Gas

Investigation results to date include the following:

1984 Soil sampling

1992 Soil gas measurements from vadose zone monitoring wells located off-base

1992 Shallow soil gas measurements from off-base areas

1993 Soil gas measurements from borings on or near the cap

During 1984, soil samples from four borings (depths ranging from about 16 to 65 feet) were analyzed for VOCs. Ethyl benzene, toluene, xylenes, and 4-methyl-2-pentanone were detected, all at concentrations less than 1 mg/kg (CH2M Hill, 1992).

In 1992, soil gas sampling showed significant VOC concentrations in three nested vadose-zone monitor wells (MW-7, 8, and 9) located off-base, about 75 feet west of the base boundary. The deepest well (about 80 feet) contains maximum reported concentrations of approximately 500 ppmv total VOCs (CH2M Hill, 1993a and 1993b). Three rounds of soil gas samples were also analyzed by method TO-14 using gas chromatography and mass spectrometry in an off-site laboratory. Out of 39 compounds analyzed, 21 compounds were identified and quantified. In general, the highest VOC concentrations were reported for analytes commonly detected in groundwater, including TCE, DCE11, and FC113 at concentrations greater than 10 ppmv (see glossary for identification of chemicals).

Shallow soil gas samples (less than 10 feet deep) were collected off-base north of the monitoring well clusters in 1992. Samples were analyzed for a limited suite of compounds, including those most commonly detected in the vadose-zone monitor wells and at Site S. Two compounds—DCE11 and FC113—were detected in significant concentrations near the western boundary of the base.

Results from recently completed borings located on or near the low-permeability cap indicate significant VOC concentrations in two borings, with DCE11 as the primary contaminant and TCE and TCA11 as secondary ones (see glossary for analyte identification). The highest concentrations were reported from boring C-3, located about 475 feet north of the off-base vadose-

Section 2

zone wells. This boring was drilled through the trench at Site 3 and contained high concentrations near the water table: 3,360 ppmv of DCE11 at 80 feet below ground level and 1,190 ppmv at 90 feet below ground level. Much lower concentrations were detected from shallower depths to 70 feet below ground level, averaging less than 25 ppmv total VOCs.

Investigation Results: Groundwater

Groundwater contamination in the vicinity of Site 3 and beneath all of OU D is documented by many monitor wells in both the A and B zones. In the A zone, the highest contaminant concentrations are reported from wells located within or near the low-permeability cap. Compounds detected at maximum concentrations exceeding 100 µg/L at least once since 1986 are: BZ, DCA11, DCA12, DCBZ12, DCE11, DCE12, MTLNCL, MVC, PCE, TCA111, and TCE. In the B zone, fewer of these analytes have been detected, and they have generally been at much lower maximum concentrations. Only DCE11, MTLNCL, and TCE have exceeded 100 µg/L at least once, and most other analytes have not been reported above 20 µg/L. In general, concentrations in the groundwater have been decreasing since 1986 after the installation of the cap and the start of groundwater treatment.

Interpretation

The history of use of Site 3 indicates that the site, or at least a portion of the site, received substantial quantities of solvents and may be a significant source of VOCs. The limited characterization completed to date is insufficient to determine whether Site 3 is a significant VOC source. Boring C-3, drilled through the northern end of Site 3, showed less than 25 ppmv total VOCs to 70 feet below ground level, but more than 2,500 ppmv total VOCs at depths below 70 feet. This concentration profile suggests that the soil gas contamination is closely associated with groundwater contamination. The groundwater table at McAFB has dropped more than 30 feet in the last 30 years due to climate and heavy withdrawals. The recession of the contaminated groundwater may have created a contaminated zone near the capillary fringe, or smear zone. The observations of high VOC concentrations close to the groundwater may indicate the presence of the smear zone, or it may be related to degassing of contaminated groundwater. Neither of these conceptual models points to Site 3 as a significant source of vadose-zone contamination responsible for the observed off-base soil gas contamination. However, Site 3 cannot be ruled out as a significant source since most of the site has not been investigated.

Section 2

Conclusion

The question of whether or not Site 3 is a significant source can only be resolved by further investigation. Since soil gas contamination south of boring C-3 has not been investigated, a total of three additional characterization borings, approximately 200 feet apart and drilled to the water table, will be completed. These borings will be converted to extraction wells if there is indication of soil gas contamination. If VOC concentration is low, the possibility of operating one or more of the extraction wells at Site 3 using excess capacity at Site S will be considered. If VOC concentration is high at all three sites, a vapor treatment system will be installed at Site 3. If there is no indication of soil gas contamination in one of the new borings, it will be converted to a monitoring well.

SVE implementation at Site 3 areas will be coordinated with other related activities in the OU D, including the operation and expansion of the SVE system at Site S, additional off-base gas sampling efforts, and efforts to characterize other sources.

Section 3
JUSTIFICATION OF SVE REMOVAL ACTION

As discussed in section 4 of the General Evaluation Document, justification of a removal action using SVE as the presumptive remedy is dependent on site-specific information. The first consideration is an evaluation of the feasibility of applying SVE at the site, which is based on satisfying criteria regarding contaminant volatility, air permeability in soil, and depth of contamination.

Near Site 3, the primary contaminants are TCA111, DCE11, and TCE, all of which meet the physical-chemical requirements to classify them as volatile compounds. The Site S treatability study, initiated in March 1993, found soil permeability at the site to be generally greater than 10^{-1} darcies. Therefore, the soils near Site 3 can be expected to satisfy the air permeability criterion. Finally, the depth of VOC contamination in the vadose-zone, as demonstrated by soil gas measurements, is deeper than the required minimum of 5 feet.

The second consideration is an evaluation of the need for a removal action. Because the soil-gas contaminant plume underlying OU D has moved off base, it is appropriate to take early action. The initial effort centers on Site 3, which is in a strategic location for placing extraction wells to interrupt the flow of contaminants off-base, regardless of their origin. In addition, Site 3 is also the closest of the suspected sources in OU D to the area where off-base contamination has been observed.

In summary, according to the criteria set out in the General Evaluation Document, Site 3 has been determined to be a candidate site for a removal action using SVE as the presumptive remedy.

Section 4
REMOVAL ACTION OBJECTIVES

Scope

The scope for this removal action will vary depending on the result from additional characterization efforts at Site 3. This removal action is triggered by concern over gas migration off-base and is being initiated before identification of the primary VOC source. Therefore, characterization becomes a significant portion of the removal action.

The scope consists of the following:

- Further characterization of Site 3 for VOC source identification
- Removal of a significant amount of VOC if a source is identified
- Interception of the migration of VOC gas from other sources under the OU D cap or from contaminated groundwater
- Further characterization of the nature and extent of the off-base soil gas plume

ARARs

Chemical-specific ARARs: As identified in the General Evaluation Document

Action-specific ARARs: As identified in the General Evaluation Document

Location-specific ARARs: None

Section 5
CONCEPTUAL DESIGN AND COST

Conceptual Design

The amount and extent of contamination at Site 3 in OU D is not presently known. The removal action will characterize the site and remove any contamination that is detected. Three boreholes have been proposed as part of the characterization effort. They will be spaced at intervals of approximately 200 feet. The conceptual design described here is based on the scenario that all three boreholes are found to be near source areas and that all three would be converted to extraction wells. Under this scenario, the three wells may provide sufficient flow rate to use a vapor treatment system. The proximity of the Site 3 removal action to the Site S treatability study location reduces the distance that would otherwise be required for utility connections. It is anticipated that the electrical transformer at Site S can be used for the removal action at Site 3.

Use of activated carbon to control emissions can be investigated after contaminant concentrations decrease to less than 200 ppm. Because the mass of contaminants at the site is not known, the optimal time for this changeover cannot be reliably estimated.

If the characterization boreholes do not indicate the presence of a significant source, vapor treatment system may not be necessary at Site 3. Alternatives involving use of excess capacity at Site S will be investigated in this case.

Cost Estimate

The itemized cost estimate for the removal action site at Site 3 is shown in table 5-1. The cost estimate includes the use of a catalytic oxidizer equipped with a scrubber to destroy contaminants and control emissions. Based on the treatability study results, an operating period for the SVE system of at least one year can be expected if significant quantities of VOC contamination are found. If the catalytic oxidizer operates for an entire year, the project cost is estimated to be $1.49 million, including equipment purchase. If contaminant concentrations are assumed to decrease to less than 200 ppm after nine months of operation, activated carbon could be installed to control emissions for the remaining three months. The capital cost of a trailer-mounted carbon system would be approximately $120,000, with a carbon replacement cost of $36,000 per month. Use of the catalytic oxidizer for nine months and activated carbon for three months would reduce the removal action project cost to $1.48 million, including the purchase of all equipment. This marginal cost savings indicates that conversion to activated carbon might not be very cost-effective.

Section 5

Cost	Design Basis	Unit Cost	Item Cost
Site Preparation:			
Gas Connection	300 feet of 2 inch polyurethane line	$7.50/foot	$2,300
Electrical Connection	300 feet of buried 4 inch conduit	$5.00/foot	1,500
Water Connection	300 feet of buried 2 inch PVC pipe	$14.00/foot	4,200
Grading and Equipment Platform	3000 sq. feet of subgrade and concrete	$6.00/sq. foot	18,000
Well Installation	3 wells at a total depth of 300 feet	$75.00/foot of depth	22,500
Equipment:			
Vacuum blowers	2 blowers rated 500-800 scfm @ 7-12 inches of Hg	$17,000	$34,000
Air -Water Separator	1 unit 2000 scfm rated @ 18 inches of Hg	$4,000	4,000
Manifold and Piping	600 feet of 4-8 inch PVC pipe, fittings and support	$30.00/foot	18,000
Emission Control System	Catalytic oxidizer w/scrubber	$355,000	355,000
Engineering:	20% of site and equipment cost		92,000
Mobilization:	10% of site and equipment cost		46,000
		Total Capital Cost:	$597,500
Operation and Maintenance:	90% uptime, 648 hours per month		*Monthly Operating Cost:*
Natural Gas	2425 scfh	$3.50/1,000 scf	$5,500
Electricity	105 kw	$.075/kWh	5,100
Water	617 gph	$1.00/1,000 gal	400
Scrubber Chemicals	254 pph	$350/ton	28,800
Waste Disposal	500 gph	$3.00/1,000 gal	1,000
Testing and Monitoring	1 stack test per month, 9 well analyses per month	$2,500/sample	25,000
Operating Labor	90 hrs for 2 part-time techs and part-time sample collector	$70/hour	6,300
Reporting	1 monthly operations report and prorated summary report	$6,000/month	6,000
		Monthly Operating Cost:	$78,100
		Annual Operating Cost:	$937,200

Table 5-1
SVE Cost Estimate for OU D /Site 3

Section 6
IMPLEMENTATION PLAN FOR SVE REMOVAL ACTION

The schedule for preparing the documents to support an SVE removal action at Site 3 is shown in figure 6-1. The Site 3 draft final document was made available for public comment on 1 September 1993. This is followed by a 30-day public review period and a 15-day extension if requested, for a total of 45 days. A 45-day period is planned for McAFB to respond to public comments, finalize the EE/CA, and prepare the responsiveness summary and the action memorandum. The responsiveness summary addresses public comments and the action memorandum is the primary decision document for removal action. All these documents will be placed in the Information Repository and Administrative Record.

A schedule for implementing an SVE system is shown in figure 6-2 to illustrate the sequence of milestone events: design, procurement, off-site equipment assembly, installation, operation, and termination. The SVE design will begin after the date of contract award. An eight-month design period is planned for the traditional design cycle of 10, 40, 90, and 100 percent design submittals and reviews. A one-month interval between the completion of the design and the beginning of equipment installation is allowed for equipment procurement. A three-month period is planned for equipment assembly, which can be done off-site, and a one-month period is planned for on-site installation. The period of operation will be determined as part of the periodic reviews of SVE system performance, currently set for six-month intervals.

The SVE removal action for Site 3 is part of a basewide removal action including five areas: IC 1, IC7, OU C1, OU D/Site S, and OU D/Site 3. SVE equipment will be installed sequentially at these sites rather than at all sites concurrently. McAFB has not developed an integrated schedule for all five areas, but intends to start the SVE system installation for the last of these five areas before 1 October 1994.

McAFB is not liable for delays in any planned activity in the event of Force Majeure, which is an unforeseen condition as described in the Interagency Agreement among the Air Force, Region 9 of the U.S. Environmental Protection Agency, and the state of California.

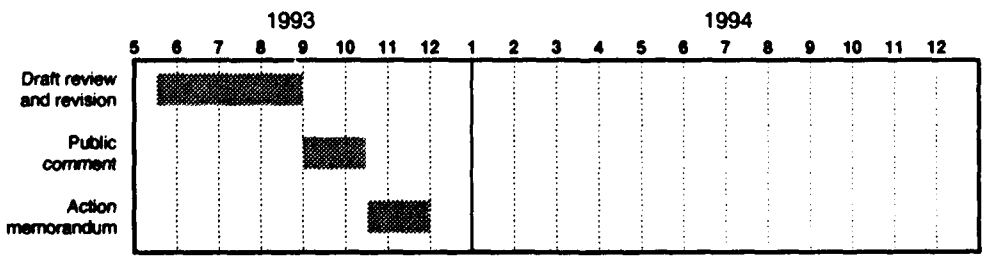

Figure 6-1
Schedule for EE/CA Site Specific Document for OU D /Site 3

Section 6

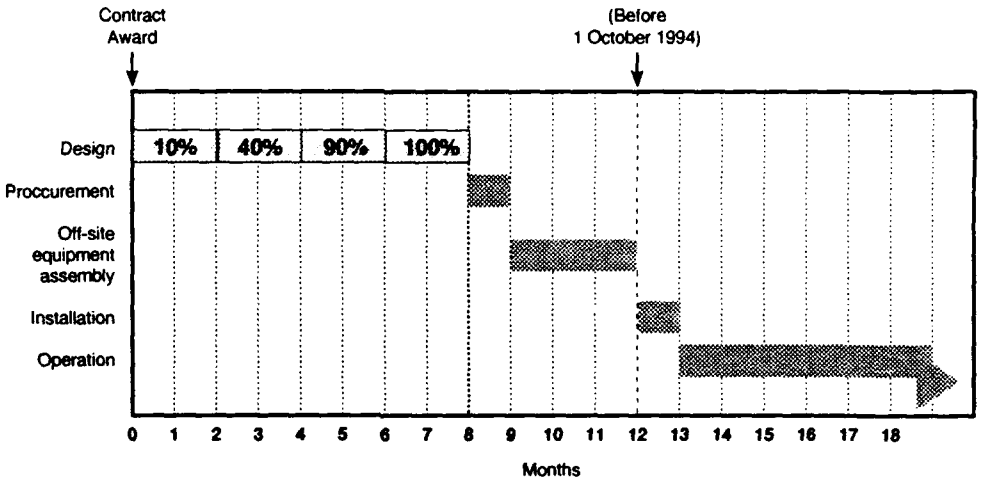

Figure 6-2
Schedule for EE/CA Site Specific Document for OU D /Site 3

REFERENCES

CH2M Hill, *Draft Technical Memorandum, Confirmed Site 3 Operable Unit D, Preliminary Assessment,* November 1992.

CH2M Hill, *Draft Technical Memorandum, Vadose-Zone Wells Quarterly Sampling, June and September, 1992,* January 1993a.

CH2M Hill, *1993 First Quarter Vadose-Zone Wells Sampling Report,* February 1993b.

GLOSSARY

Chemical Codes

ACE	acetone
BRME	bromomethane
BUTADIEN	1,3-butadiene, erythrene
BZ	benzene
BZLCL	benzyl chloride
BZME	toluene
C8N	n-octane
CHLOROPR	2-chloro-1,3-butadiene
CLBZ	chlorobenzene
CLEA	chloroethane
CLME	chloromethane
CTCL	carbon tetrachloride
CO	carbon monoxide
CYHEXANE	cyclohexane
DCA11	1,1-dichloroethane
DCA12	1,2-dichloroethane
DCBZ12	1,2-dichlorobenzene
DCBZ13	1,3-dichlorobenzene
DCBZ14	1,4-dichlorobenzene
DCE11	1,1-dichloroethene
DCE12C	cis-1,2-dichloroethene
DCE12T	trans-1,2-dichloroethene
DCP13C	cis-1,3-dichloropropene
DCP13T	trans-1,3-dichloropropene
DCPA12	1,2-dichloropropane
EBZ	ethylbenzene
EDB	1,2-dibromoethane (ethylene dibromide)
FC11	trichlorofluoromethane
FC113	1,1,2-trichloro-1,2,2-trifluoroethane
FC12	dichlorodifluoromethane
FC114	freon 114, dichlorotetrafluoroethane
MTLNCL	methylene chloride
MVC	vinyl chloride, monovinylchloride
NOx	nitrogen oxide
PCA	1,1,2,2-tetrachloroethane
PCE	tetrachloroethene
PROP	propylene, propene
SOx	sulpur oxides
STY	styrene
TBME	bromoform
TCA	trichloroethane
TCA111	1,1,1-trichloroethane
TCA112	1,1,2-trichloroethane

GLOSSARY

TCB124	1,2,4-trichlorobenzene
TCE	trichloroethene
TCLME	chloroform
TMB124	1,2,4-trimethylbenzene
TMB135	1,3,5-trimethylbenzene (mesitylene)
UNK	unknown compounds
VC	vinyl chloride
XYLMP	m,p-xylene (sum of isomers)
XYLO	0-xylene (1,2-dimethylbenzene)
XYLP	p-xylene (1,4-dimethylbenzene)

General

ARAR	Applicable or relevant and appropriate requirements
cfm	Cubic feet per minute
EE/CA	Engineering Evaluation-Cost Analysis
EPA	U.S. Environmental Protection Agency
IAG	Interagency Agreement
IC	Investigative cluster
IRP	Installation Restoration Program
McAFB	*McClellan Air Force Base*
NCP	National Contingency Plan
OU	Operable Unit
ppb	parts per billion
ppm	parts per million
ppmv	parts per million by volume
scfm	standard cubic feet per minute
SMAQMD	Sacramento Metropolitan Air Quality Management District
SVE	Soil vapor extraction
TRC	Technical Review Committee
VOC	Volatile organic compound